

REMARKS

Claims 46 – 91 are currently pending.

The Examiner indicated in the office action dated 11/02/2007 that claim 21 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicants hereby express their thanks to the Examiner. Accordingly, new claim 80, discussed below, includes essentially the limitations of canceled claims 17, 19 and 21, as well as the additional limitation of canceled claim 40.

New claims 46 – 91 substantially include elements of originally-filed and previously-presented canceled claims 1 – 45, although sometimes formulated differently. Some of new claims 46 – 91 also include to a limited extent subject matter from the description of the invention that was not previously explicitly claimed. Support in the specification for the subject matter of each of the new claims is indicated herein, as follows.

New independent claims 46 and 58 include limitations similar to those of canceled claims 1 and 17, 39 -- 41 and 19, with the important additional limitation that removing metal from the field region includes removing metal isotropically from the acceleration region and the field region. Support for the limitation of removing metal isotropically from the acceleration region and the field region is found in the specification at, among other places: page 2, line 28; page 16, lines 25 – 30; FIG. 10. Support for the limitation of continuing plating copper until a height of plated copper/deposited metal in the acceleration region is higher than a field copper height in the field region is found in cancelled claim 41 and in the description at: page 17, lines 3 – 5; FIGS. 9 and 13.

Support for new claims 47 and 59 is found in the specification at: page 16, line 30 – page 17, line 3.

New claims 48 and 60 are similar to canceled claims 2 and 18.

New claims 49 -- 50 and 61 – 62 are supported in the specification at: page 16, lines 25 – 30; FIG. 10.

New claims 51 and 63 supported in the specification at: page 2, lines 25 – 31; page 8, line 31 – page 9, line 3; page 16, lines 25 –27.

New claims 52 and 66 are supported by canceled claims 1 and 26.

New claims 53 and 68 are supported by canceled claims 42 and 43.

New claims 54 and 64 are supported by canceled claims 1 and 25.

New claims 55 and 65 are supported by canceled claims 6 and 27 and FIG. 11.

New claims 56 and 72 are supported by canceled claims 7, 22 and 29 and FIG.

5.

New claims 57 and 70 are supported by canceled claims 42 – 43 and in the description at page 3, lines 20 – 22.

New claim 66 is similar to canceled claim 26.

New claim 67 is similar to canceled claim 45.

New claim 68 is similar to canceled claim 42

New claim 69 is supported in the description at page 3, lines 20 – 22.

New claim 71 is similar to canceled claim 28.

New claims 73 -- 77 are supported by canceled claims 30 – 34.

New claim 78 is similar to canceled claims 10, 24 and 38.

New claim 79 is supported in the specification, among other places, at: FIG. 10.

New independent claim 80 includes essentially the limitations of canceled claims 17, 19 and 21, as well as the additional limitation of canceled claim 40.

New claims 81 – 91 depending from claim 80 contain limitations already discussed above.

The paragraph numbering below corresponds approximately to the numbering used in the office action.

Claim Rejections – 35 USC §102

1. A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. MPEP §2131, citing *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2

USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. MPEP §2131, citing *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Claims 1 -- 4, 7 -- 9, 11 -- 16, 39 were rejected under 35 USC 102(e) as being anticipated by Matsuda et al., U.S. Patent Application Publication US 2004/0226827, published November 18, 2004 (hereinafter "Matsuda et al.").

Claims 1 -- 4, 7 -- 9, 11 -- 16, 39 have been canceled.

It is believed that the limitations of new independent claim 46 differentiate it from the teaching of Matsuda et al.

The difference in copper height/thickness in Matsuda et al. is undesirable and its reduction and elimination are a goal of Matsuda et al., as discussed in Matsuda et al. in Example 1, para. [0109-0110], referring to FIG. 5C. Rule 132 Declaration of Steven T. Mayer (hereinafter "Mayer Declaration"), ¶ 6. In the present invention, a height difference is desired and is an element of independent claim 46. For example, claim 47 includes the express limitation of plating copper until the difference between a height of plated copper in the acceleration region and a field copper height in the field region approximates a desired final thickness of the copper wiring line.

New independent claim 46 includes the express limitation that removing metal from the field region includes removing metal isotropically from the acceleration region and the field region. Matsuda et al. teach using CMP (chemical mechanical polishing) to remove plated copper film 31, seed layer 30 and barrier layer 29 (FIG. 5C) from the entire surface down to the top surface of insulating film 26 (FIG. 5D). Mayer Declaration, ¶ 7, referring to Matsuda et al., para. [0112]. CMP is not an isotropic technique. Mayer Declaration, ¶ 7. It is used generally in the art to planarize an unsmooth surface, that is, to make it smooth, as depicted in FIG. 5D of Matsuda et al. Mayer Declaration, ¶ 7. In contrast, an isotropic metal removal technique, as claimed in new claim 46, removes the same material at substantially the same rate from all locations of a surface, thereby substantially maintaining the original general shape of the surface (even if lowering it uniformly), as depicted in FIG. 10. Mayer Declaration, ¶

8. As a result of isotropic metal removal, plated copper protrudes above the resist layer (after removing metal from the field region) in preferred embodiments in accordance with claims 46 and 58. Mayer Declaration, ¶ 8. In contrast, in Matsuda et al., CMP planarizes the surface and the plated metal does not protrude above insulating film 26. Mayer Declaration, ¶ 8. For example, compare FIG. 5D of Matsuda et al. with FIG. 10 of the present application. Mayer Declaration, ¶ 8.

Also, Applicants respectfully disagree with the Examiner regarding the rejection of claim 2 and the interpretation of the teaching of Matsuda et al. concerning the difference in metal height /thickness between the acceleration region and the field region. In the present application, canceled claim 2 (new claim 48) claimed plating copper until the difference was at least 3 μm . In contrast, Matsuda et al. disclose a difference of only 0.4 μm (FIG. 6, para. [0114, 0116]) and 0.2 μm (FIG. 7, para. [0122]). Mayer Declaration, ¶ 9.

2. Claims 17 – 20, 22 – 23, 25 – 26, 28, 40 – 42, 44 -- 45 were rejected under 35 USC 102(e) as being anticipated by Matsuda et al., U.S. Patent Application Publication US 2004/0226827.

Claims 17 – 20, 22 – 23, 25 – 26, 28, 40 – 42, 44 -- 45 have been canceled.

It is believed that the limitations of new independent claim 58 differentiate it from the teaching of Matsuda et al. for reasons discussed above with reference to new independent claim 46.

Also, for reasons discussed above concerning the rejection of canceled claim 2, Applicants respectfully disagree with the Examiner regarding the rejection of claim 18 (new claim 60) and the interpretation of the teaching of Matsuda et al. concerning the difference in metal height /thickness between the acceleration region and the field region.

Regarding new claim 67 and the rejection of canceled claims 44 – 45, Applicants note that paragraph [0050] of Matsuda et al. teaches forming a metal seed layer, but does not mention electroless deposition.

3. Claims 29 -- 37 were rejected under 35 USC 102(e) as being anticipated by Matsuda et al., U.S. Patent Application Publication US 2004/0226827.

Claims 29 -- 37 have been canceled.

Claim Rejections -- 35 USC §103

4. The criteria for establishing a *prima facie* case of obviousness are summarized in the MPEP:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure.

MPEP 2143, citing *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed.Cir. 1991).

Claims 5, 21, 43 were rejected under 35 USC 103(a) as being unpatentable over Matsuda et al., U.S. Patent Application Publication US 2004/0226827, in view of Nakamura et al., U.S. Patent Application Publication US 2001/0013472, published August 16, 2001 (hereinafter "Nakamura et al.").

Claims 5, 21, 43 have been canceled.

The limitation of removing metal substantially isotropically from the acceleration region and the field region is included in new independent claims 46 and 58 and dependent claim 82. The limitation of isotropic etching is included in new claims 49, 61 and 83. The limitation of isotropic wet etching is included in new claims 50, 62 and 84.

In the Office Action, the Examiner suggested that Nakamura et al., at page 3, para.

[0051], teach a wet etch to remove copper from the substrate and implicitly from the field region. With regard to the rejections of claims 5, 21, 43 and the allowability of new claims, Applicants respectfully disagree with the Examiner's interpretation. At page 3, para. [0051], Nakamura et al. teach using a copper-etching solution to remove plating promoter from the surface of copper film 21, which is essentially a copper seed layer. Mayer Declaration, ¶ 10. The etching solution is neither isotropic nor is it used to remove copper/metal from the field region after plating copper/depositing metal in the acceleration region and field region. Mayer Declaration, ¶ 10. The etching described in paragraph [0051] cannot possibly be isotropic because if it were, there would be no selective removal of plating promoter from the substrate. Also, at page 4, para. [0060], Nakamura et al. teach patterning by etching, which as a practical matter, can only be accomplished by masking the surface prior to etching. Mayer Declaration, ¶ 11. Furthermore, the method could not be isotropic to achieve the selective metal removal as shown between Figs. 4 and 5 of Nakamura et al. Mayer Declaration, ¶ 11. Thus, the combination of the etching in Nakamura et al. with the method of Matsuda et al. does not teach all the claim limitations of the currently pending claims. Mayer Declaration, ¶ 12. Furthermore, Matsuda et al. need a planarization technique, such as CMP, to planarize their substrate. Mayer Declaration, ¶ 12. The etching solution of Nakamura et al. could not perform this function. Mayer Declaration, ¶ 12. Thus, there is no motivation or suggestion in the references or in the art to combine the references as suggested by the Examiner, and there would be no expectation of success. Mayer Declaration, ¶ 12.

5. Claims 10, 24, 38 were rejected under 35 USC 103(a) as being unpatentable over Matsuda et al., U.S. Patent Application Publication US 2004/0226827, in view of Nakamura et al., U.S. Patent Application Publication US 2001/0013472.

Claims 10, 24, 38 have been canceled.

Allowable Subject Matter

6. Claims 6, 27 were objected to as being dependent upon a rejected base claim, but

would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 6 and 27 have been canceled.

As explained above, new independent claim 80 includes substantially the limitations of canceled claims 17, 19 and 21, as well as the additional limitation of canceled claim 40.

For the reasons explained above, it is believed that pending claims 46 -- 91 are not anticipated by or obvious in view of the cited references. Therefore, consideration and allowance of claims 46 -- 91 are respectfully requested. If the Examiner believes that a telephone conference would facilitate amendment of the claims into allowable form, then a telephone conference is also requested.

Respectfully submitted,



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